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INSTRUCTIONS

FOR

INSTALLATION AND OPERATION

OF

FREQUENCY MODULATED GENERATORS

TYPES 150-A AND 150-AS
TYPES 151-A AND 151-AS
TYPES 152-A AND 152-AS
TYPES 154-A AND 154-AS
TYPES 155-A AND 155-AS

BOONTON RADIO CORPORATION
BOONTON, NEW JERSEY
U. S. A.

150-A — 155AS

6510
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INSTRUCTIONS

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INSTALLATION AND OPERATION

OF

FREQUENCY MODULATED GENERATORS

TYPES 150-A AND 150-AS
TYPES 151-A AND 151-AS
TYPES 152-A AND 152-AS
TYPES 154-A AND 154-AS
TYPES 155-A AND 155-AS

BOONTON RADIO CORPORATION
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GENERAL DESCRIPTION

GENERAL:

These instructions relate to all types of Frequency Modulated Generators listed on the title page. The various types of generators are similar in appearance and construction, differing largely in respect to frequency coverage.

PURPOSE:

The first Generator (Type No. 150-A) in this series was developed to assist engineers engaged in the design of frequency modulated equipment, such as receivers, transmitters, amplifiers, limiters and components, for use in the frequency modulation (FM) broadcasting band (42-50 megacycles). This instrument has been modified with respect to frequency coverage from time to time as required by the demands of war and the commercial services. (NOTE: The frequency ranges of the various types are given on page 8.)

OPERATING PRINCIPLE:

These generators supply a signal voltage at the output terminals in two frequency ranges: (1) the high frequency range, corresponding to the carrier frequency of the frequency modulated transmission, and (2) the low frequency range, corresponding to the frequency of the intermediate amplifier circuits of the frequency modulated receiver. The high range is obtained from the sum frequencies of the fixed and variable radio frequency (RF) oscillators contained within the generator; the low range is obtained from the difference frequencies of these two oscillators.

The fixed RF oscillator is frequency modulated by means of an audio frequency (AF) oscillator and a reactance tube; thus frequency modulation (FM) which is unaffected by adjustments of the output signal mean frequency is provided. Independent amplitude modulation (AM) of the signal voltage is provided by impressing an AF voltage on the detector input.

The internal AF oscillator supplies five fixed audio frequencies for modulation purposes. An AF voltmeter of the copper oxide type is calibrated in kilocycles deviation for FM, and also for 30% amplitude modulation.

In summary these modulation features, in conjunction with the terminal posts provided for connecting an external AF oscillator, afford the following types of modulation on each frequency range:

1. Frequency Modulation by means of the internal AF oscillator.
2. Amplitude Modulation by means of the internal AF oscillator.
3. Frequency Modulation by means of an external AF oscillator.
4. Amplitude Modulation by means of an external AF oscillator.
5. Simultaneous Amplitude and Frequency Modulation by means of external Amplitude Modulation in the presence of internal or external Frequency Modulation.

The standard RMA pre-emphasis circuit is provided and may be switched into the external frequency modulation circuit.

The output voltage of the internal AF oscillator is available for visual alignment purposes and for general laboratory work.

SELECTIVITY MEASUREMENTS:

For the purpose of selectivity measurements minor variations of the output mean frequency may be made by use of the vernier dial which tunes the fixed oscillator. Since the main frequency dial tunes only the variable oscillator, the frequency increment (in kilocycles) provided by the vernier dial is unaffected by the setting of the main dial.

R. F. OUTPUT SYSTEM:

The RF output system consists of (a) an output voltmeter having an expanded scale calibrated from 1 to 10 microvolts, and an associated variable output control; (b) a decade attenuator with multipliers of X0.1 to X10,000; (c) an external coaxial cable and terminal unit with an output impedance of 55 ohms (maximum); (d) a one-volt output tap of approximately 500 ohms impedance. The voltage at the tap may be varied from 0.1 volt to 1 volt; thus the total range of RF output voltage provided by the generator is continuously variable from 0.1 microvolt to 1 volt.

CALIBRATIONS:

The meters and dials indicate directly in terms of RF output voltage, signal frequency, kilocycles deviation (FM), etc. Push button switches are used to select and indicate the internal AF oscillator frequencies and RF output voltage multiplying factors.

POWER SUPPLY:

The power supply is housed in a separate cabinet. This reduces the amount of bench space required and improves the frequency stability of the oscillators. The effect of line voltage variations is greatly reduced by means of the voltage regulating feature of the power unit.

INSTALLATION

The Frequency Modulated Generator and its Power Unit are supplied completely equipped with tubes and are ready to operate. Before making any connections the Power Unit nameplate should be checked to see that it conforms to the voltage and frequency rating of the power line to which it is to be connected. The following table will be found helpful.

Type of Power Unit	*Rating of Power Unit*	*Use on power line of*
150-R	115 volts, 60 cycles	105-125 volts, 60 cycles
150-R250	230 volts, 50 cycles	210-250 volts, 50 cycles

Because of the voltage regulating feature of the Power Unit the operation of the Frequency Modulated Generator is quite uniform over the indicated range of line voltage. However, the output voltage of the Power Unit is a function of the input voltage frequency; hence a power source having a constant frequency must be used. This requirement is fully met by most power lines, provided, of course, that the frequency rating of the line equals the Power Unit frequency rating.

A ground connection should be made to the binding post in the lower left corner of the Generator front panel marked GND.

There are two cables leading from the Power Unit. The cable carrying the four-opening plug should first be connected to the receptacle in the rear of the Generator cabinet. The other cable should then be connected to the power line. The ON-OFF switch (item 1, page 5) located in the Power Unit controls all power to the Power Unit and Generator. The pilot light (item 2, page 5) indicates when the power is ON.

OPERATION

The various controls of the Generator and their functions are described as follows, proceeding in general from left to right across the panel. In this description the numbers in parentheses refer to the photograph on page 5.

ON-OFF SWITCH (1) and PILOT LIGHT (2):

The ON-OFF switch controls all power to the Power Unit and Generator. The pilot light indicates when the power is "ON."

ZERO SETTING OF METERS:

Before operating the Generator check the mechanical-zero-setting of the modulation meter (10) and output voltmeter (18). These should be set to zero by means of the screw-driver adjustment in the lower part of the meter case. If the Generator has been operating, turn the power OFF and allow one minute for the tubes to cool before performing the adjustments (see also Zero Setting of Output Voltmeter on page 4).

MODULATION FREQUENCY SWITCH (3):

To select any one of the five internal fixed audio modulating frequencies depress the button marked with the number indicating the desired frequency. (NOTE: The buttons for frequencies of 1000 cycles and over contain the letter K. For example, a marking of 1K = 1 kilocycle.)

EXTERNAL SWITCH BUTTON (Red–EXT) (4):

This button is depressed when it is desired to use an external modulating source connected to the GND and EXT binding posts (see EXTERNAL CONNECTIONS, page 4).

"GND" BINDING POST (5):

A ground connection should be made to this post.

"EXT", "SYN" and "AMP" BINDING POSTS (6), (7) and (8):

See EXTERNAL CONNECTIONS, page 4.

PRE-EMPHASIS SWITCH (9):

The standard RMA pre-emphasis circuit is contained within the instrument. When using frequency modulation this circuit may be employed in conjunction with an external modulating source such as speech, music or an audio oscillator (see EXTERNAL CONNECTIONS, page 4). The pre-

emphasis circuit is not associated with the internal AF oscillator.

MODULATION METER (10):

The modulation meter is calibrated directly in kilocycles deviation for FM. There are two scales, A and B, either of which may be selected by means of the modulation meter switch (11). The modulation meter is also calibrated at 30% amplitude modulation.

FM-AM SWITCH (12):

This switch selects the manner in which the RF output signal is to be modulated by means of the internal AF oscillator. Either frequency modulation (FM) or amplitude modulation (AM) may be selected.

FREQUENCY MODULATION: With the switch set to FM, frequency modulation is obtained. The deviation in kilocycles is indicated by the modulation meter on either scale A or B as selected by the modulation meter switch (11). The modulation control knob (13) adjusts the deviation.

AMPLITUDE MODULATION: With the FM-AM switch set to AM, amplitude modulation is obtained. The modulation meter has but one calibrated point, namely 30%, and is to be adjusted to this reading by means of the modulation control knob (13). The modulation meter switch (11) must be set to the B position.

OUTPUT SIGNAL FREQUENCY:

The main frequency dial (14) carries two calibration ranges. The "low" range is to be read when the frequency range switch (15) is thrown to LOW. The "high" range is to be read when the switch is thrown to HIGH. When the vernier frequency dial (16) is set to zero the main frequency dial is read directly. For other vernier dial settings the output signal mean frequency is the algebraic sum of the main dial and vernier dial readings. Note that the "sense" or "sign" of the vernier dial calibration depends upon the setting of the frequency range switch.

A vernier drive (17) is provided for the main frequency dial.

R.F. OUTPUT VOLTAGE:

An RF output voltage range of 0.1 microvolt to approximately 0.1 volt is available at the binding posts of the output unit (21). The output voltmeter (18) is calibrated in microvolts and its reading is adjusted by means of the output voltage control knob (19). The column of six push buttons (20) actuates the decade attenuator switch. When the top button marked 10K is depressed (for example) the reading of the output voltmeter is to be multiplied by 10,000 to obtain the "no-load" voltage; when the next button 1K is depressed, multiply by 1000, etc. (NOTE: For voltages above 0.1 volt see ONE-VOLT JACK (23) below.)

OUTPUT UNIT (21):

This unit terminates the coaxial cable (22) projecting from the lower right side of the generator panel and is for the purpose of connecting the output voltage (adjusted as described above) to the receiver or other apparatus to be tested. The output voltage exists between the two binding posts, the one marked GND being connected to the outer conductor of the coaxial cable.

The output impedance at the output unit is 55 ohms or less at all voltage and frequency settings. The coaxial cable used has a length of 3 feet and a characteristic impedance of approximately 55 ohms. A terminating resistor of 55 ohms is contained within the output unit, and is permanently connected in parallel with the cable at the binding posts. When using any attenuator button except 10K, the RF voltage is fed to the cable through the attenuator, thus placing approximately 5½ ohms resistance in parallel with the cable at the generator end. When using the 10K button the attenuator resistors are disconnected and the cable is fed directly through a 500-ohm voltage-dropping resistor.

ONE-VOLT JACK (23):

This jack provides output voltages exceeding the 0.1 volt maximum available at the output unit. A plug (not shown in the photograph) is provided with the Generator for connection, or a 4-inch length of ⅛-inch diameter brass rod may be substituted. The voltage is adjusted by means of the output voltage control knob (19).

The maximum voltage available depends to some extent on the type of external loading employed (without load the maximum voltage available at the jack is approximately 1 volt across the internal impedance of 500 ohms). The output voltmeter (18) reads the voltage at the jack within the Generator (the voltmeter tube is connected to the jack). A reading of 10 microvolts on the meter corresponds to approximately 1 volt at the jack, a reading of 5 microvolts corresponds to approximately 0.5 volt, etc. If knowledge of the voltage at the end of a line

connected to the jack is desired, an external voltmeter should be employed.

CAUTION

The plug must be removed from the jack when the output unit (21) is being used.

ZERO SETTING OF OUTPUT VOLTMETER:

The output voltmeter (18) is adjusted to zero by means of the electrical-zero control knob (24). The adjustment is performed with the output voltage control knob (19) in the full counter-clockwise position. (NOTE: The mechanical zero setting must have been previously performed as described on page 2.)

EXTERNAL CONNECTIONS:

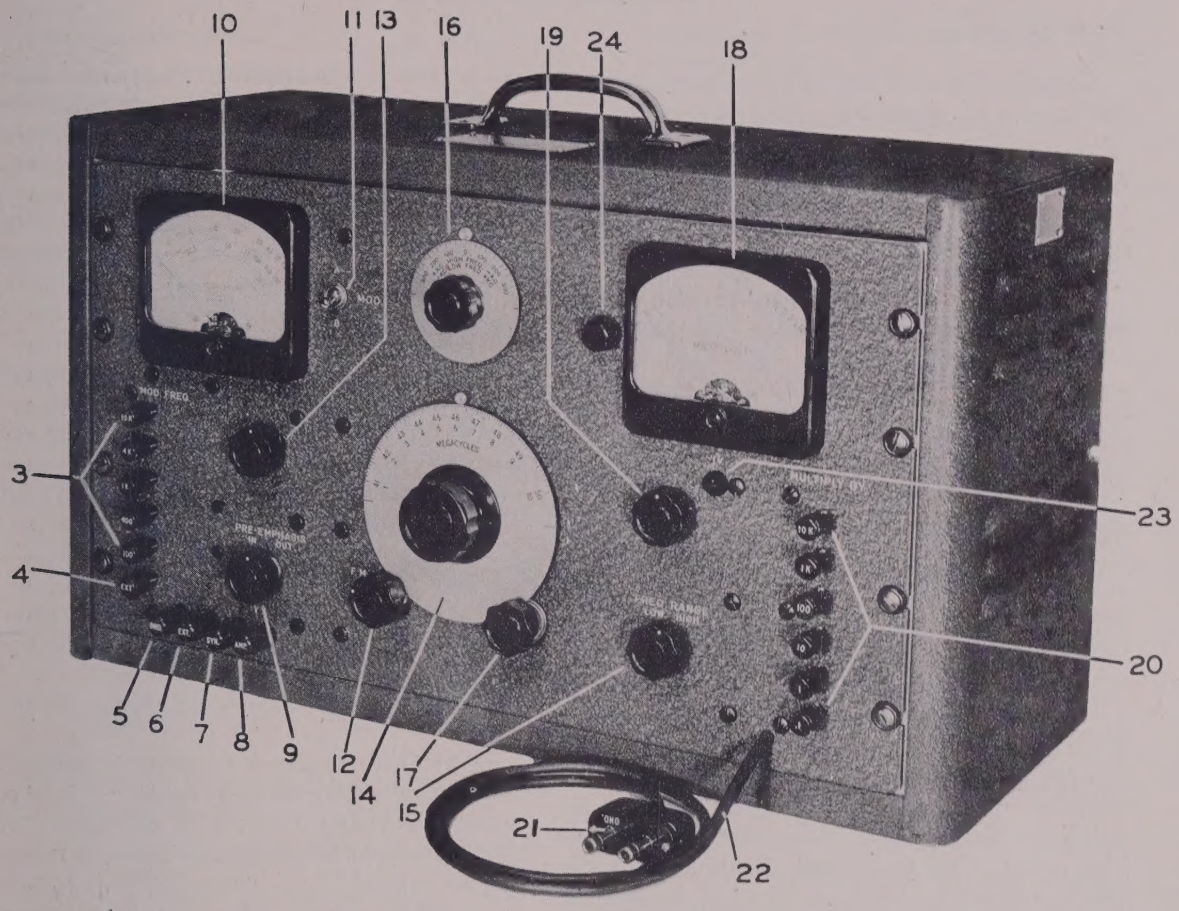
The "EXT", "SYN" and "AMP" terminal posts (6), (7) and (8) may be used as described below.

Frequency Modulation by means of an external AF oscillator may be obtained as follows: (a) Apply an AF voltage (100 to 10K cycles) of between 10 and 15 volts at the GND and EXT binding posts. The input impedance between these posts is approximately 500 ohms. (b) Disconnect the internal AF oscillator by depressing the red external switch button, EXT. (c) Throw the pre-emphasis switch to the OUT position. (d) Throw the FM-AM switch to the FM position. (e) Adjust the deviation by means of the modulation control knob (13) and read the deviation in KC directly on the modulation meter (read scale A or B depending upon the modulation meter switch setting). (f) The *pre-emphasis circuit* may be introduced if desired by throwing the pre-emphasis switch to the IN position. The attenuation introduced by this circuit may require an increase in the external applied voltage, the power input not to exceed 2 watts. The pre-emphasis circuit precedes the modulation meter in the modulating system; hence, the modulation meter will read the deviation correctly if the frequency of the external oscillator is varied step-by-step. Program tests (using speech or music) may also be made; however, the characteristics of the modulation meter are not suitable for obtaining an accurate indication of the deviation produced by this type of modulation.

Amplitude Modulation by means of an external AF oscillator may be obtained as follows: (a), (b) and (c) are same as above. (d) Throw the FM-AM switch to the AM position. (e) Throw the modulation meter switch to the B position. (f) By means of the modulation control knob (13) adjust for 30% amplitude modulation as indicated by the modulation meter.

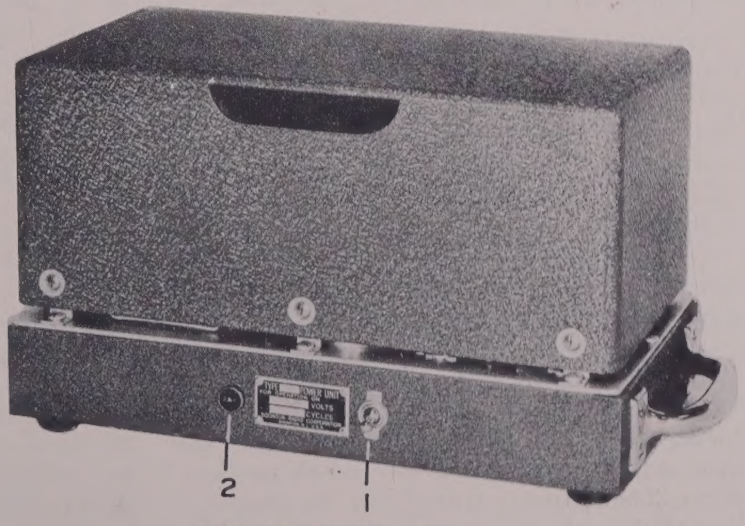
Amplitude Modulation in the presence of Frequency Modulation may be obtained as follows: (a) Adjust the instrument for frequency modulation with the internal AF oscillator as described on page 3 (or for frequency modulation with an external AF oscillator as described above). (b) Apply an external AF voltage (100 to 10K cycles) of 15 volts between the GND and AMP binding posts thus producing 30% amplitude modulation. The input impedance between the GND and AMP posts is roughly 5000 ohms.

"SYN" BINDING POST (7): The output voltage of the internal AF oscillator is available for synchronization purposes in conjunction with a cathode-ray oscillograph and for general uses. Connection should be made to the SYN and GND binding posts. The modulation control knob (13) adjusts the voltage. On Types 150 and 155 Generators divide the kilocycle reading of the modulation meter by 10 to determine the approximate voltage; on Types 151, 152, and 154 divide by 5.



TYPE 150-A FREQUENCY MODULATED GENERATOR

1. Power ON-OFF Switch.
2. Pilot Light.
3. Modulation Frequency Switch (5 buttons).
4. External AF Oscillator Switch Button (Red—"EXT").
5. Ground Binding Post ("GND").
6. External AF Oscillator Binding Post ("EXT").
7. Synchronization Binding Post ("SYN").
8. Amplitude Modulation Binding Post ("AMP")
9. Pre-Emphasis Switch.
10. Modulation Meter.
11. Modulation Meter Switch.
12. FM-AM Switch.
13. Modulation Control.
14. Main Frequency Dial.
15. Frequency Range Switch.
16. Vernier Frequency Dial.
17. Vernier Drive.
18. Output Voltmeter.
19. Output Voltage Control.
20. Decade Attenuator Switch.
21. Output Unit.
22. Co-axial Cable.
23. One-Volt Jack.
24. Zero Control for Output Voltmeter.



TYPE 150-R POWER UNIT

OPERATING NOTES

POWER UNIT:

A certain amount of audible hum is normal to the operation of the regulating type of power unit.

MODULATION METER:

It is normal for the pointer of the modulation meter to quiver slightly at medium to high settings.

ACTION OF R.F. OUTPUT VOLTAGE CONTROL:

There is normally a considerable difference in the R.F. output voltage when switching from one frequency range to the other. This is due to a change in the effective taper of the output voltage gain control. On the low frequency range the action of this control is fairly linear, while on the high frequency range a tapered effect is obtained resulting in a slow rate of rise in the output over the first part of the rotation, then a more rapid rise as full gain is approached.

The effect is most pronounced with the main frequency dial set for the lower frequencies, and at medium gain settings, where there may be as much as a 5 to 1 reduction in the output voltage (and in the output voltmeter reading) when switching from the "low" range to the "high" range. The voltage may be readily restored to its former level, if desired, by rotation of the output voltage control.

SPURIOUS OUTPUT FREQUENCIES:

The circuits following the detector do not give complete attenuation of the undesired detector responses. Hence, voltages of undesired or spurious frequency are present in the generator output. For example, second harmonic voltage from the individual (fixed and variable) oscillators will be found in the output.

Erroneous results will be had if a spurious output voltage is inadvertently used in testing. To aid in identifying the spurious output frequencies the following table lists the fundamental frequencies of the individual oscillators. It is to be noted that responses due to the fixed oscillator only will be affected by the tuning of the vernier frequency dial but not by the main dial. Responses due to the variable oscillator only will be affected by the main dial but not by the vernier dial and will carry essentially no frequency modulation.

Generator Type No.	*Fundamental Frequency of Fixed Oscillator (Vernier dial at "0")*	*Fundamental Frequency of Variable Oscillator (for full calibrated range of Main dial)*
150	20.0 Mc	21.0—30.0 Mc
151	14.5 Mc	15.5—25.5 Mc
152	9.5 Mc	10.5—18.5 Mc
154	13.0 Mc	14.0—26.0 Mc
155	18.5 Mc	19.5—31.5 Mc

ACCURACY OF R.F. OUTPUT VOLTAGE:

The spurious output voltages described above contribute to the output voltmeter reading, in addition to the desired voltage. However, a selective receiver tuned to the desired output frequency responds only to the desired output voltage. Hence the output voltmeter is calibrated during manufacture in terms of desired voltage. However, since the ratio of spurious voltage to total voltage varies as the output voltage and frequency are adjusted, this calibration cannot be accurately held under all conditions of operation and the indication of the output voltmeter should be regarded as being only approximately accurate.

On the high frequency range the accuracy of the multiplying factors shown by the attenuator buttons is subject to some error. This, of course, directly affects the accuracy of the voltage delivered to the output unit.

AMPLITUDE MODULATION:

The amplitude modulation feature is intended to be used only in checking frequency modulation receivers, limiters, discriminators, etc. for response to an amplitude modulated signal. It is not recommended for testing amplitude modulation receivers, detectors, etc. since the calibration mark (30%) is only approximately accurate and some distortion is normally present.

ACCURACY OF A.F. VOLTAGE OBTAINED FROM "SYN" AND "GND" BINDING POSTS:

The method of reading this voltage in the modulation meter (see "SYN" BINDING POST, page 4) is described solely for the convenience of the user. No attempt is made to hold close limits of accuracy in this voltage since certain types of error can be, and are, compensated for in the factory adjustment of the RF section of the generator, and therefore do not necessarily represent an error in the frequency modulation (deviation) indication.

SERVICING

GENERAL:

In general, because of its specialized design, it is recommended that this equipment be returned to the manufacturer when servicing is required. However, a few exceptions are noted below.

FUSES:

The attachment plug which connects the power unit to the power line contains two Type 3AG, 2-ampere fuses. In case of failure these may readily be removed for replacement by pushing them out with a sharp pointed tool.

NOTE: The power units of early manufacture are not provided with fuses.

TUBES:

Tube replacements may be made by the user of this equipment, but with the possibility of some sacrifice of the original accuracy of performance. The latter is particularly true of the RF section of the generator. If best results are desired it is recommended the equipment be returned to the manufacturer who has facilities for checking the overall performance.

If it is desired to replace the tubes they may be made accessible as follows:

CAUTION

Make certain the equipment is disconnected from the power line before performing the following dis-assembly operations.

First remove the eight oval-headed screws and cup washers which secure the front panel of the generator to the cabinet, then slide the entire panel assembly from the cabinet. The audio unit is located at the left-hand end of this assembly (when facing the front side of the panel) and its tubes are now exposed. The individual tube locations are marked except that the Type S-6 Lamps are the two small bulbs located at the left side of the audio unit.

The RF unit tubes may now be made accessible by removing the two screws holding the large shield cover (located in center-rear of the entire panel assembly), and then removing the cover. Note that the cover is grounded by the action of a series of spring fingers. When replacing the cover, care must be taken that the proper spring action is restored. The individual tube locations are marked.

Access to the rectifier tube of the Power Unit is had by removing the six screws and cup washers securing the top cover, and then removing the cover. To gain access to the pilot lamp remove the top plate of the chassis by taking out the eight screws located around the edge of the plate. Six of these screws also secure the six cover supporting brackets.

A list of the tubes used in this equipment is given on page 9. Note that the Type 6H6 Tube is specially selected and can be obtained only from Boonton Radio Corporation.

SPECIFICATIONS FOR TYPE 150-SERIES FREQUENCY MODULATED GENERATORS

R.F. RANGES

Type No. of Generator	*High Frequency*	*Low Frequency*	*Vernier (see note 1)*
150	41-50 Mc	1-10 Mc	± 300 Kc
151	30-40 Mc	1- 7 Mc	± 300 Kc
152	20-28 Mc	1- 5 Mc	± 150 Kc
154	27-39 Mc	1- 7 Mc	± 300 Kc
155	38-50 Mc	1-10 Mc	± 300 Kc

FREQUENCY MODULATION RANGE

Type No. of Generator	*Deviation Ranges (see note 2)*	*Maximum deviation for 5% distortion (see note 3)*
150	0-75 Kc and 0-225 Kc	75 Kc
151	0-35 Kc and 0-100 Kc	50 Kc
152	0-35 Kc and 0-100 Kc	50 Kc
154	0-35 Kc and 0-100 Kc	50 Kc
155	0-75 Kc and 0-225 Kc	75 Kc

INTERNAL AUDIO MODULATING FREQUENCIES

Audio Frequencies Group Designation (see note 4)	*Internal Fixed Audio Modulating Frequencies*
A	100, 400, 1000, 4000 and 10,000 cycles
AS	150, 400, 1000, 2500 and 5,000 cycles

NOTE 1: The mean frequency of the output signal at any setting on the "high" and "low" ranges may be varied as shown by use of the vernier dial.

NOTE 2: The frequency modulation meter is calibrated in two ranges of deviation as shown.

NOTE 3: The deviation shown is the maximum value permissible for distortion of not more than 5% on frequency modulation when using the internal 400-cycle modulation. The distortion decreases as the deviation is reduced. When using an external AF oscillator of pure wave-form the distortion is 3% or less for the deviation shown.

NOTE 4: Either of these standard groups is normally supplied. The group designation is added to the type number as a suffix. For example Type Number 152-AS indicates a Type 152 Generator provided with group AS internal audio frequencies.

R.F. OUTPUT VOLTAGE RANGE:

The RF output voltage is continuously variable from 0.1 microvolt to approximately 0.1 volt at the output unit, and from 0.1 volt to approximately 1 volt at the one-volt jack.

AMPLITUDE MODULATION:

Calibration is provided for 30% amplitude modulation.

POWER SUPPLY UNIT:

The Power Supply Unit is of the voltage regulating type and is contained in a separate cabinet. It is supplied in either of the following types:

Type	*For power line of*
150-R	105-125 volts, 60 cycles
150-R 250	210-250 volts, 50 cycles

Dimensions:	Type 150-R:	15½" x 7½" x 8"
	Type 150-R250:	15½" x 7½" x 9½"
Weight:	Type 150-R:	29 lbs.
	Type 150-R250:	32 lbs.

TUBES:

The following tubes are used:

	Quantity	*Type*
In the Generator	2	6F6
	2	6V6
	2	6J5
	2	6AC7
	1	6H6*
	2	S-6 Lamp, 120V., 6 W.
In the Power Unit	1	5V4G
	1	Mazda 47 Pilot Lamp

*Specially selected.

DIMENSIONS:

All parts of the Generator are mounted on a standard relay rack type panel, dimensions 19″ x 10½″. The overall dimensions of the instrument mounted in its metal cabinet are: height 13½″, length 21½″, depth 10″.

WEIGHT:

The weight of the Generator is 38 lbs.

CAPACITORS USED IN TYPE 150 FREQUENCY MODULATED GENERATOR

This list also applies to Types 151, 152, 154 and 155 Generators with exceptions as indicated

Capacitor No.(†)	*Description*	*Capacitance Tolerance (%)*
C1	.01 mfd. — 600v paper	3
C2	.001 mfd. — 500v mica	3
C3	.01 mfd. — 600v paper	3
C4	.001 mfd. — 500v mica	3
C5	.25 mfd. — 400v paper	10
C6	8 mfd. — 450v electrolytic	
C7	50 mfd. — 25v electrolytic	20
C8	8 mfd. — 450v electrolytic	
C9	.0028 mfd. — 500v mica	3
C10	.25 mfd. — 400v paper	
C11	.01 mfd. — 600v paper	
C12	.01 mfd. — 600v paper	
C14	.001 mfd. — 500v mica	10
C15	.001 mfd. — 500v mica	10
C16	.01 mfd. — 600v paper	
C17	.01 mfd. — 600v paper	
C18	.001 mfd. — 500v mica	10
C19	.001 mfd. — 500v mica	10
C20	.001 mfd. — 500v mica	10
C21	.01 mfd. — 600v paper	
C22	.001 mfd. — 500v mica	10
C23	500 mmfd. — 500v mica	10
C24	44 mmfd. — air trimmer	
C25	25 mmfd. — Zero Temp. Coeff.	10(X)
C26	500 mmfd. — 500v mica	10(X)
C27	.01 mfd. — 600v paper	
(s)C28	5-17 mmfd. — variable air	
C29	28 mmfd. — air trimmer	
C30	25 mmfd. — 500v mica	5
C31	.001 mfd. — 500v mica	10
C32	.01 mfd. — 600v paper	
C33	.001 mfd. — 500v mica	10
(s)C34	66 mmfd. — variable air	(X)
C35	28 mmfd. — air trimmer	
C36	25 mmfd. — 500v mica	5
C37	16 mmfd. — air trimmer	
C38	8 mmfd. — air trimmer	(X)
C39	50 mmfd. — 500v mica	10
C40	.001 mfd. — 500v mica	10
C41	.001 mfd. — 500v mica	10
C42	.01 mfd. — 600v paper	
C43	.01 mfd. — 600v paper	
C44	8 mfd. — 450v electrolytic	
C45	.01 mfd. — 600v paper	
C46	.001 mfd. — 500v mica	10
C47	28 mmfd. — air trimmer	(X)
C48	.01 mfd. — 600v paper	
C49	.01 mfd. — 600v paper	
C50	.001 mfd. — 500v mica	10
C51	28 mmfd. — air trimmer	
(s)C51R	Matched to transformer T51R	
C52	.01 mfd. — 600v paper	
C52A	.001 mfd. — 500v mica	10
C53	.01 mfd. — 600v paper	
C54	(Not used on Type 150)	(X)
C55	.001 mfd. — 500v mica	10
C56	(Not used on Type 150)	(X)
C57	(Not used on Type 150)	(X)
C58	(Not used on Type 150)	(X)
C59	.001 mfd. — 500v mica	10
C61	8 mfd. — 450v electrolytic	
C62	16 mfd. — 450v electrolytic	
C81	.01 mfd. — 600v paper	
C82	(Not used on Type 150)	(X)
C84	(Not used on Type 150)	(X)
C85	(Not used on Type 150)	(X)
C90	8 mfd. — 150v electrolytic	

(†) Refers to Schematic Circuit Diagram.
(X) For Types 151, 152, 154 and 155 Generators see Supplementary Capacitor List.
(s) Item manufactured to Boonton Radio Corporation specification; not obtainable elsewhere.

SUPPLEMENTARY CAPACITOR LIST FOR TYPES 151, 152, 154 and 155 GENERATORS

Capacitor No.(†)	*Type of Capacitor*	*Capacitance Tolerance (%)*	*Type No. of Generator and Nominal Value of Capacitor*			
			Type 151	*Type 152*	*Type 154*	*Type 155*
C25	Zero Temp. Coeff.	10	.....	.....	20 mmfd.	25 mmfd.
	Neg. Temp. Coeff.	10	20 mmfd.	20 mmfd.	.....	.....
C26	500v mica	10	100 mmfd.	150 mmfd.	250 mmfd.	500 mmfd.
(s)C34	Variable Air		160 mmfd.	160 mmfd.	160 mmfd.	160 mmfd.
C38	Air Trimmer		8 mmfd.	8 mmfd.	8 mmfd.	16 mmfd.
C47	Air Trimmer		.....	.....	.....	28 mmfd.
	Ceramic Trimmer		45 mmfd.	45 mmfd.	45 mmfd.	.....
C54	500v mica	10	50 mmfd.	100 mmfd.	20 mmfd.	.....
C56	Zero Temp. Coeff.	10	.....	20 mmfd.	20 mmfd.	.....
C57	Zero Temp. Coeff.	10	.....	.....	.....	25 mmfd.
	Neg. Temp. Coeff.	10	10 mmfd.	10 mmfd.	10 mmfd.	.....
C58	Air Trimmer		28 mmfd.	28 mmfd.	28 mmfd.	.....
C82	500v mica		.....	.....	20 mmfd.	.....
C84	500v mica		.....	.....	5 mmfd.	.....
C85	500v mica		.....	.....	10 mmfd.	.....

(†) Refers to Schematic Circuit Diagram.
(s) Item manufactured to Boonton Radio Corporation specification; not obtainable elsewhere.

INDUCTORS USED IN TYPE 150 FREQUENCY MODULATED GENERATOR

This list also applies to Types 151, 152, 154 and 155 Generators with exceptions as indicated

Inductor No.(†)	*Description*
L 1	Reactor—30 H., 700 ohms, 35 ma. DC
L 3	Choke—8 mh., univ. wound
L11	Choke—8 mh., univ. wound
(s) L12	R.F. Choke
(s) L13, L13A	R.F. Choke, double wound
L21	Choke—8 mh., univ. wound
(s) L22	R.F. Choke
(s) L23	R.F. Choke
L24	Choke—8 mh., univ. wound
L25	Choke—8 mh., univ. wound
(s) L26	Phasing Coil, adjusted
(s) L27	R.F. Choke
(s) L28, L28A	Fixed Osc. Coil
(s) L29, L29A	Variable Osc. Coil
(s) L30	Coil
(s) L31	Tank Coil
L32	Choke—8 mh., univ. wound
(s) L33	Coil (Used on Types 151, 152 and 154 only)
L52	Filter Choke—10 H., 200 ma.
L53	Filter Choke—10 H., 200 ma.

(†) Refers to Schematic Circuit Diagram.
(s) Item manufactured to Boonton Radio Corporation specification; not obtainable elsewhere.

RESISTORS USED IN TYPE 150 FREQUENCY MODULATED GENERATOR

This list also applies to Types 151, 152, 154 and 155 Generators with exceptions as indicated

Resistor No.(†)	*Description*	*Resistance Tolerance (%)*	
R1	½W—200,000 ohms	3	For "A" Audio Switch
R2	½W— 40,000 ohms	3	
R3	½W— 16,000 ohms	3	
R4	½W—160,000 ohms	3	
R5	½W— 40,000 ohms	3	
R6	½W— 16,000 ohms	3	
R1	½W—125,000 ohms	3	For "AS" Audio Switch
R2	½W— 40,000 ohms	3	
R3	½W— 16,000 ohms	3	
R4	½W— 65,000 ohms	3	
R5	½W— 32,000 ohms	3	
R6	½W—106,000 ohms	3	
R7	½W— 3,000 ohms	10	
R8	½W— 3,000 ohms	10	
R9	Potentiometer, WW, S.D. Adj. 5,000 ohms		
R10	½W— 1 megohm	10	
R11	½W— 8,000 ohms	10	
R12	½W—100,000 ohms	10	
R13	1W— 500 ohms	10	
R14	1W— 4,000 ohms	10	
R15	1W— 1,000 ohms	10	
R16	Potentiometer, Carbon 100,000 ohms		
R17	1W— 500 ohms	10	
R18	1W— 500 ohms	10	
R19	1W— 2,000 ohms	10	
R20	½W— 66,000 ohms	5	
R21	½W— 9,000 ohms	5	
R22	½W— 2,000 ohms	5	
R23	½W— 230 ohms	5	
R24	½W— 5,000 ohms	5	
R25	2W— 500 ohms	5	
R26	2W— 50,000 ohms	10	
R29	(Not used on Type 150)	(X)	
R30	½W— 30 ohms	10(X)	
R31	1W— 500 ohms	10	
R32	2W— 1,000 ohms	10	
R33	½W— 50 ohms	10	
R34	½W— 25,000 ohms	10	
R35	1W— 500 ohms	10	
R36	1W— 25,000 ohms	10	
R37	½W— 25,000 ohms	10	

RESISTORS USED IN TYPE 150 FREQUENCY MODULATED GENERATOR

This list also applies to Types 151, 152, 154 and 155 Generators with exceptions as indicated *(Continued)*

Resistor No.(†)	*Description*	*Resistance Tolerance (%)*
R38	½W—350,000 ohms (subject to adjustment)	
R39	½W— 5,000 ohms	10
R40	½W— 1,000 ohms	10
R41	½W— 500 ohms	10
R42	½W— 50,000 ohms	10
R43	½W— 1,000 ohms	10
R44	½W— 1,000 ohms	10(X)
R45	Potentiometer, Carbon 1,000 ohms	(X)
R46	½W— 230 ohms	10(X)
R47	½W— 40,000 ohms	10
R48	½W— 1,000 ohms	10(X)
R49	½W— 50,000 ohms	10
R50	½W— 25,000 ohms	10
R51	½W— 1,000 ohms	10
R52	Potentiometer, WW., S.D. Adj. 5,000 ohms	
R53	½W— 500 ohms	Special
R61	½W— 50 ohms	Special
R62	Same as above	Special
R63	Same as above	Special
R64	Same as above	Special
R65	Same as above	Special
R66	½W— 6.17 ohms	Special
R67	Same as above	Special
R68	Same as above	Special
R69	Same as above	Special
R70	Same as above	Special
R71	½W— 55.5 ohms	Special
R75	10W— 100 ohms	10
R76	10W— 50,000 ohms	10
R81	Potentiometer, WW 200 ohms	
R82	½W— 3,000 ohms	10

(†) Refers to Schematic Circuit Diagram.
(X) For Types 151, 152, 154 and 155 Generators see Supplementary Resistor List.

SUPPLEMENTARY RESISTOR LIST FOR TYPES 151, 152, 154 and 155 GENERATORS

Resistor No.(†)	*Type of Resistor*	*Resistance Tolerance (%)*	*Type No. of Generator and Nominal Value of Resistor*			
			Type 151	*Type 152*	*Type 154*	*Type 155*
R29	2 watt	10	1000 ohms	1000 ohms	1000 ohms	.....
R30	½ watt	10	50 ohms	50 ohms	50 ohms	30 ohms
R44	½ watt	10	1000 ohms	1000 ohms	2000 ohms	1000 ohms
R45	Potentiometer, Carbon		1000 ohms	1000 ohms	5000 ohms	1000 ohms
R46	½ watt	10	200 ohms	230 ohms	200 ohms	230 ohms
R48	½ watt	10	1000 ohms	1000 ohms	2000 ohms	1000 ohms

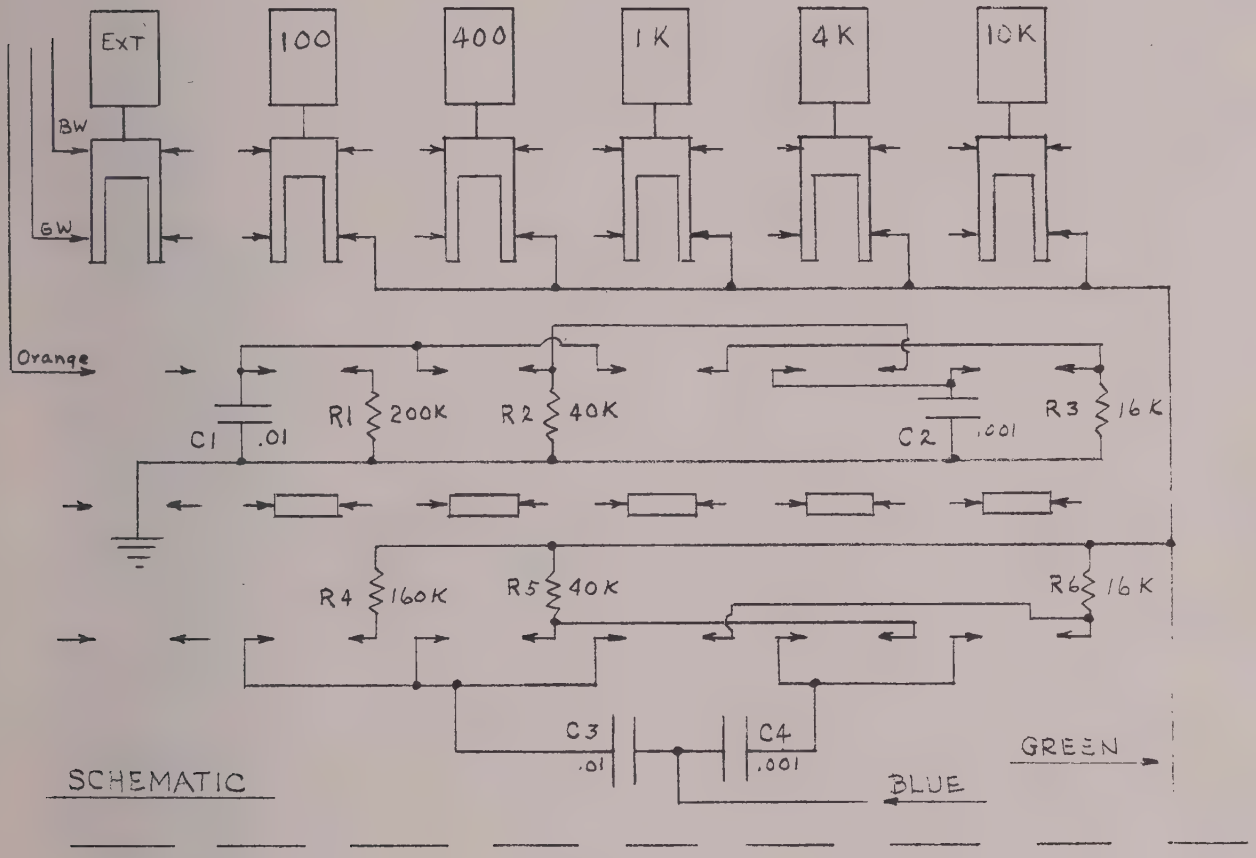
(†) Refers to Schematic Circuit Diagram.

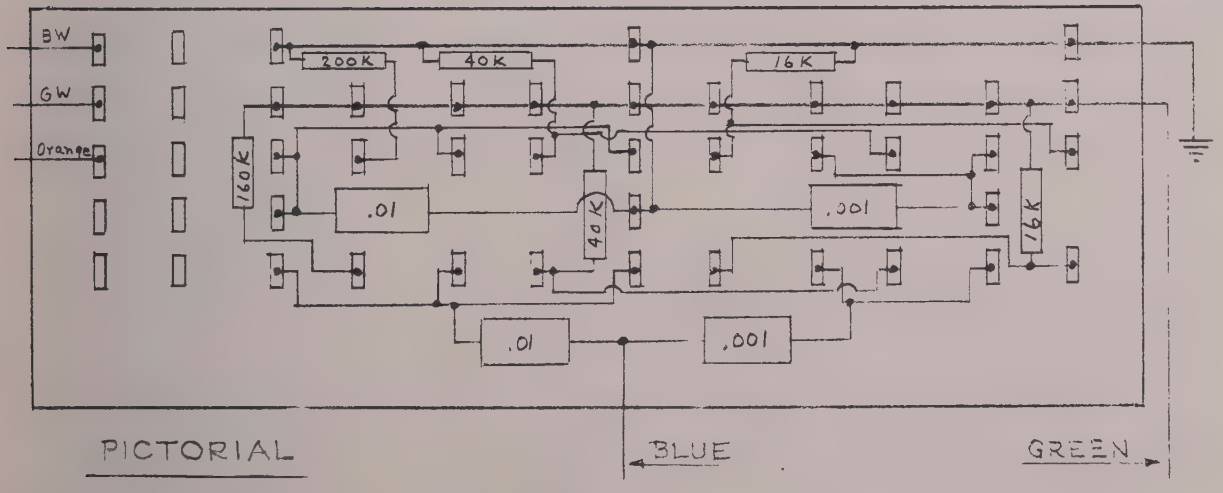
MISCELLANEOUS ITEMS USED IN TYPE 150 FREQUENCY MODULATED GENERATOR

This list also applies to Types 151, 152, 154 and 155 Generators

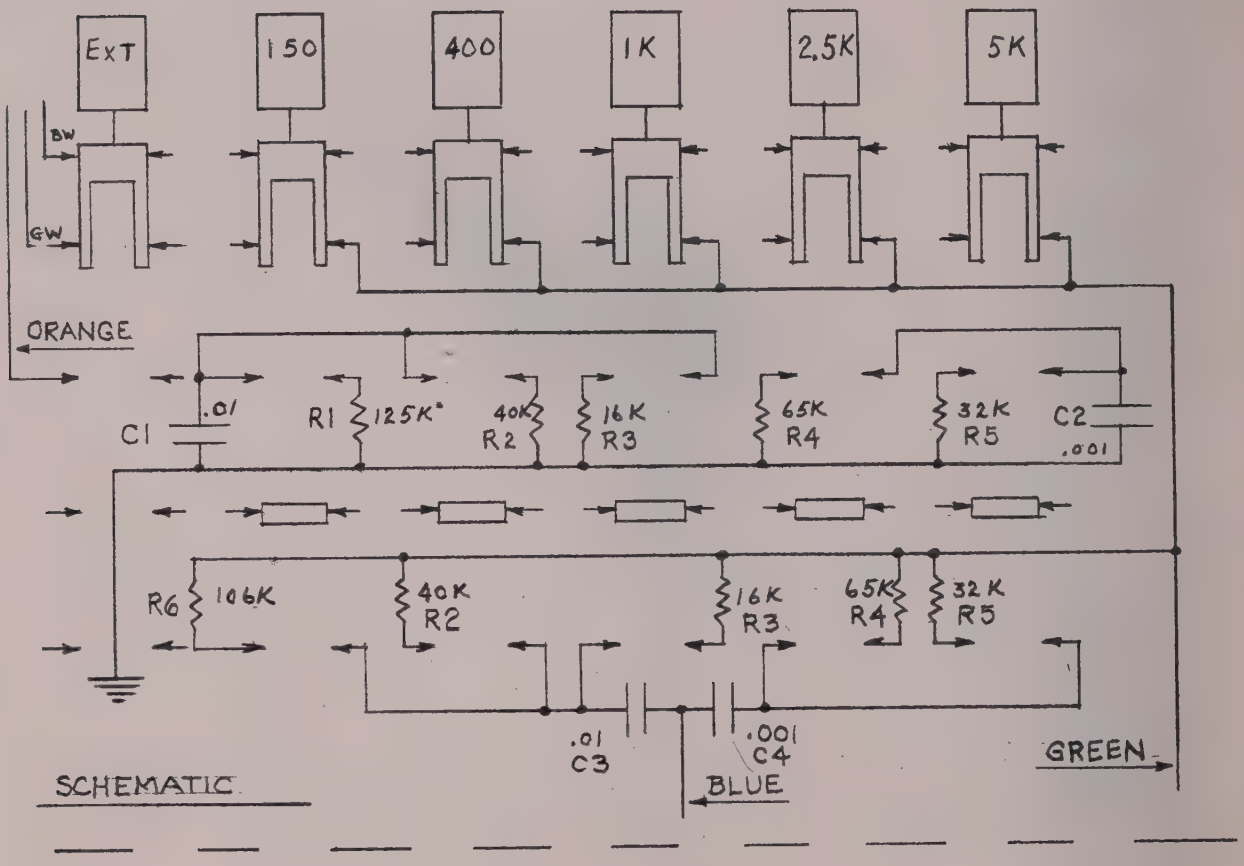
Item No.(†)	*Description*
YR1	Type S-6 Cand. Base Lamp, 120v-6W
YR2	Type S-6 Cand. Base Lamp, 120v-6W
V3	Type 6J5 Tube
V4	Type 6F6 Tube
V5	Type 6F6 Tube
V6	Type 6V6 Tube
V7	Type 6V6 Tube
V8	Type 6J5 Tube
V9	Type 6AC7 Tube
V10	Type 6AC7 Tube
(s)V11	Type 6H6 Tube (BRC special selection)
V12	Type 5V4G Tube
I13	Type 47 Mazda Pilot Lamp—6V—bayonet base
F1	Type 3AG Fuse—2 amp.
F2	Type 3AG Fuse—2 amp.
(s)M1	Modulation Meter
(s)M2	Output Voltmeter
(s)T2	Driver Transformer
(s)T51R	Power Transformer—Regulated (includes capacitor C51R)

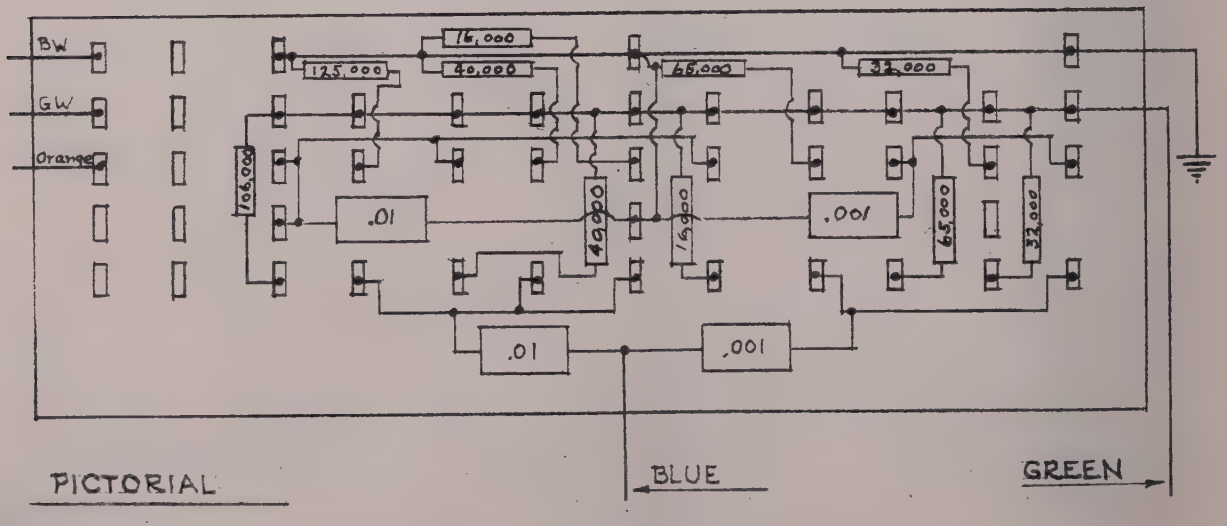
(†) Refers to Schematic Circuit Diagram.
(s) Item manufactured to Boonton Radio Corporation specification; not obtainable elsewhere.



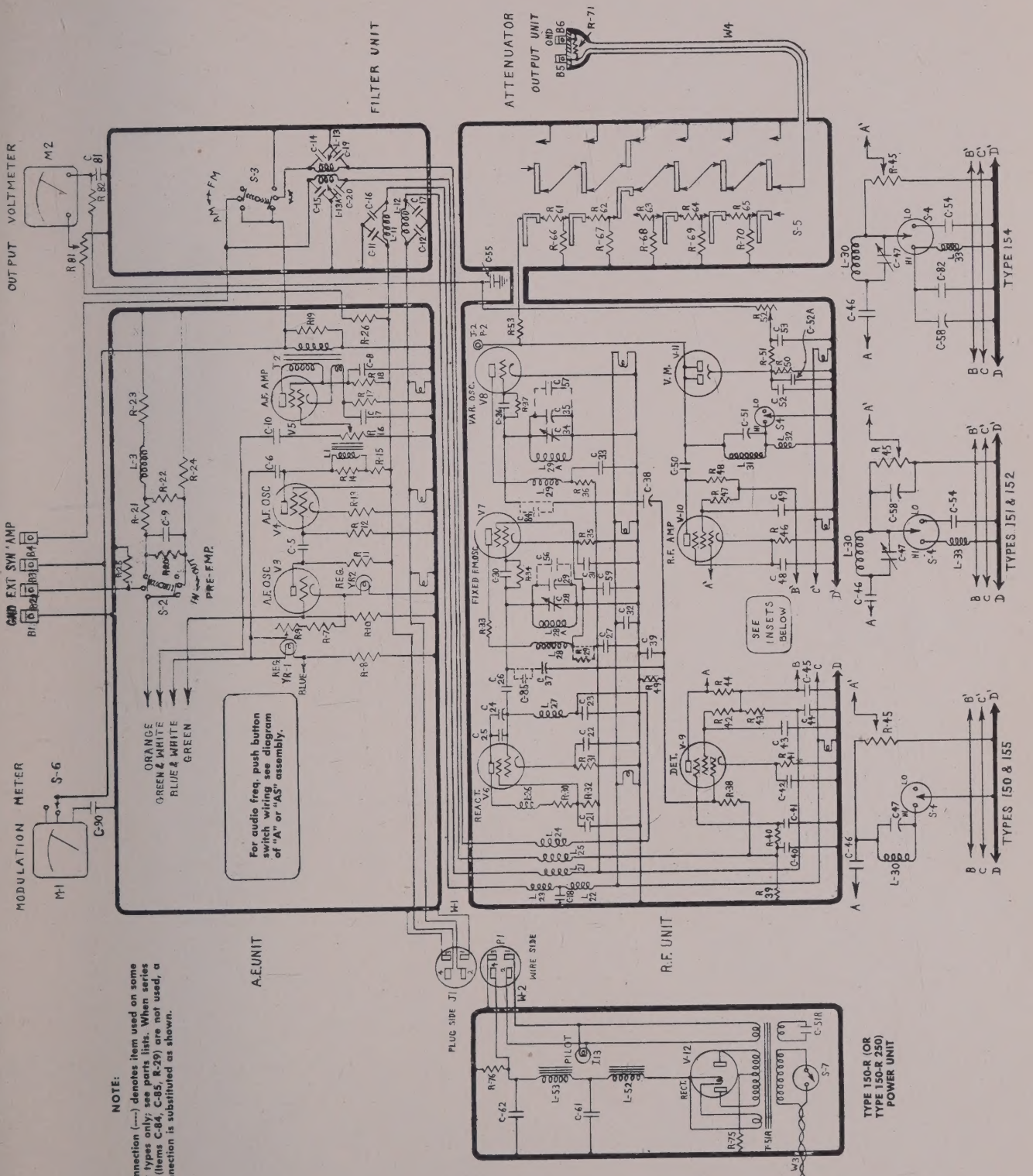


A. F. PUSH BUTTON SWITCH ASSEMBLY FOR "A" TYPE GENERATORS





A. F. PUSH BUTTON SWITCH ASSEMBLY FOR "AS" TYPE GENERATORS



NOTE:
Dotted connection (----) denotes item used on some generator types only; see parts lists. When series elements (items C-84, C-85, R-29) are not used, a direct connection is substituted as shown.

SCHEMATIC CIRCUIT DIAGRAM OF TYPES 150, 151, 152, 154 & 155 FREQUENCY MODULATED GENERATORS

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